The General Principles of Organization Applied to an Individual Manufacturing Establishment

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THE POSSIBILITIES OF EFFICIENCY IN MANAGEMENT

By various authorities we are informed that there are at least one hundred ways of defining "efficiency," and I shall venture on one of them, and that is "the percentage of money spent to the profits earned, or to the results produced."

Whatever definition we may accept, however, this is true, in economics and in management, that the result is less than the applied effort. It cannot be more than unity; it rarely reaches it. There is always some loss by friction, and the problem of the efficiency engineer is to reduce that loss.

Now, taking the mechanical field, let us see what inspiration we can draw from that as to the possibilities of this new science which we are taking as a specialty for a new organization. Take steam engineering: in Smeaton's time, about 135 years ago, it took 35 pounds of coal in a furnace to produce one horse-power; whereas, to-day it takes, with good practice, less than 1 pound. In boiler efficiency, even now we are getting only 12½ per cent. of the theoretical efficiency, and steam engineers have that great field or margin still to work upon.

Let me refer now to a product of my own factory. Twenty-three or twenty-four years ago the Weston differential pulley block was the best-known device as a self-sustaining hoisting machine. Its efficiency was about 28 per cent. It has been practically superseded, all over the world, by the Triplex chain block, the efficiency of which is 79 per cent. It is hardly likely that we can accomplish elsewhere in this field a similar increase of almost three-fold greater efficiency. These are two illustrations of what has been done in increasing mechanical

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efficiency. In human efficiency the field is a new one and an open one. It is virgin soil, almost.

Then there is the other direction, efficiency of management, management not only of industrial plants but of all kinds of business, commercial, transportation and banking. There is no field where you may not increase the efficiency of human effort. It is a new proposition. The effort in the past was to increase the productiveness of industrial plants by the larger use of machinery, and thereby to increase the output per unit of employee. But what we are learning now can be done, is to increase the productiveness of the individual human unit, by applying higher study to his individual work, and by training him how to utilize the knowledge which we so acquire.

THE BASIS OF THE SCIENCE

The movement is in full swing, although we are just starting to crystallize it by organization, and I believe that the greatest single contribution to it thus far, certainly in the industrial field, is Dr. Taylor's theory of time study. That is the Baconian system applied to industrial facts and conditions, as a basis on which to reason from them to better things; and therefore, to my mind, it marks the greatest single contribution to this new science that has yet been made. There are many others. Functional management may be put next in rank, but planning and routing and stores management are parts of this harmonious whole.

The dictionary tells us that science is knowledge acquired by systematic observation and correct thinking, which knowledge has been coördinated and arranged. That is the function of this new organization. To bring together a lot of knowledge which is in the minds and notebooks of the members, and in the records of the great corporations, to bring that knowledge together into a common fund, where it shall be available, not for the individual or one concern, but for all. It is to do for management what science has done for architecture, medicine, and engineering, by bringing together the results of the studies of all who are active in that field, and making them, in turn, available for all others.

Enough work of this kind has been done already to show that we have begun to lay the foundations of the science. The papers read in our engineering societies, and published in their journals and in books, taken collectively, constitute a definite and valuable nucleus for the new science.

Now, the results in mechanical efficiency have been obtained through the application, consciously or unconsciously, of the Baconian system of induction. The same process, I predict, will be followed in this new science, not only in its application to industrial plants, where it has first taken root and where already much has been accomplished, but in its extension from that into businesses of all kinds—transportation, merchandising, any field of activity in which the human factor is a large and essential element in the economy of the total processes, and especially where the final result depends upon the coördination of the efforts of large bodies of men.

EXAMPLES OF INCREASED EFFICIENCY

Again, resorting to past facts to illustrate future possibilities, and because I believe they will interest you as examples of concrete results in individual cases, I have put on paper a few of the results obtained at the plant at Stamford, of which I am the official head, as the result of applying this modern system of intensive efficiency under the Taylor system.

I have taken four cases, selected at random, which I will designate as A, B, C, and D.

In case A, after the system had been effectually established, there was a reduction in labor cost of the article of 50 per cent.; an increase in the wage-earnings of the operatives of 81 per cent.; and an increase in the output of 275 per cent., with the same machine.

In case B, the labor-cost was reduced 45 per cent.; the pay was increased 15 per cent., and the output increased 1.1 per cent.

In C, the labor was reduced 76 per cent. and the output was increased three and a half times. The rate of wages earned, however, was decreased 14 per cent. The explanation of that reduction in the earnings of the operatives was that the process had been so much improved that, whereas before it required highly skilled labor, it now became possible to use less highly skilled labor. But in doing these operations, the less skilled operatives earned more than they could at other occupations.

In case D, the labor cost was reduced 49 per cent., and the wages earned increased 91, and the output was increased four times.

In one case the former rate of output was 800 pieces, and the new rate was 2,900. In another, the old was 2,500, and the new 6,000. In another the old was 3,500, and the new 7,090; and in another the old was 1,750, and the new 7,000.

These are concrete examples of what efficient management can do, even where the work was previously done under conditions which up to the last few years would have been considered excellent.

The total efficiency of the department where this new system was established was so increased that, whereas in 1907, with all machinery employed, and some overtime required to get the needed output, that output was 80,000 units, in 1910, with some of the machinery not in use, and with no overtime, the output was 120,000 units. I may state that it took two and a half years, and cost about $25,000 to get the new system established in that department, an expenditure of money and time which at first seemed discouraging, but which was persevered in, and which has been justified by the outcome. I mention this for the encouragement of others who may be discouraged and in doubt.

Again, as an illustration of the benefits to be derived from functionalizing, let me give one or two concrete examples. In our own plant, to which I refer, as I have the data, we functionalized the care of belting. We have in all some 6,000 belts to take care of. Prior to 1907 the belts were taken care of as in all of the similar shops, the smaller ones by the operators at the machines, and the main belts and the jack-shaft belts by men who were not specialists in this field. In 1906 the cost per belt was 96 cents. As a result of specialization, in 1907, it was reduced to 73 cents. In 1908 it was reduced to 45 cents. In 1909 and 1910 it was reduced to 42 cents, which is about where it stands to-day. And we appear to have about reached bottom.

Here we have a reduction of cost of more than one-half from the preceding condition. And as illustrating how these things pay, the difference between the former and present cost, multiplied by the number of belts, makes $3,240 per annum, which you can put your finger on as a direct saving. Even better is the saving from having all belts adjusted properly. These results have been duplicated in many cases.

THE NEED FOR EXPERTS

Facts like these point the way to things which should be sought out and attempted in other fields of human activity in the effort to attain higher efficiency. The same method which accomplished the result in that plant will accomplish it elsewhere; namely, that of applying higher intelligence and study to the specific problems. But to succeed, the higher intelligence is needed, and it is the best economy to employ experts at the start, and then later to turn the work over to men who have been trained by them. In that connection, I may quote an excel-

lent definition by ex-Controller Metz, who defined an expert in this way: "The scientific man knows why; the practical man knows how; the *expert* knows why and how." There is a lot of sense in that definition.

The men whom we need as efficiency engineers should be experts in that sense. They need to know both the why and the how: the why in order to aid them in learning the how; and the how in order to transmit it to the men who are to do the work under their direction.

THE WORK OF SCIENTIFIC ORGANIZATION

Now, to come more directly to the topic which has been assigned to me, I will venture to define the scientific principles of efficiency organization in an industrial plant.

The first requirement is a receptive attitude, and especially at the head of the business. If the manager of the business approaches this subject in an attitude of antagonism or of such deep-seated doubt as to have no faith in it, he had better let it alone. It is not an easy problem, nor a short one. It is a very profound problem, which will take a long time to work out successfully, and, unless you have the right attitude of receptiveness at the start and at the head, you had better lay it aside until you can get those prerequisites.

The second thing is knowledge of the science down to the date when you undertake to apply it to your business. Some heads of departments may have that knowledge and are competent to apply it. They are the exception and not the rule, however; and where that technical knowledge is not possessed down to date, they should seek the expert. There has developed a new field of engineering, which we recognize as closely identified with this association and the movement it stands for, in which such experts may be found.

The third factor, in order and importance, I should put as that of functionalizing on rational lines. You cannot make much progress in any highly organized and ramified business until you have functionalized to some extent. Cut loose from the old plan of military organization, in which one man is at the head of each room, or department, or shop, with so many hands under him, and is supposed to direct and control everything that every one does. Get away from that military basis, and on to the better and more modern basis of functionalized management, under which, while that man may still remain as the captain and be responsible for discipline and general direction, other men will have charge of certain functions pertaining to the work car-

ried on in the room or shop by its occupants, each of whom are specialists in their respective fields or departments, and who are used as such in all departments of the plant.

The next in sequence is the segregation of this new system from your current work. If you attempt to combine one with the other, one or both will suffer. Probably the new system will go to the wall and not be effectively accomplished. It should be segregated, both in its management and physically, by that management being located in an office by itself.

The next essential is a competent head, best of all an outside man, having experience in this field, and not hampered by the conditions and requirements of your current work.

The next and last in order is the selection of the line of least resistance. Find out your easy problems and take those first, especially in regard to the human element. Start your work in shops or rooms where the human attitude is not antagonistic. Finally, put all of these facts together, develop your method of planning, of time studies, of stock cards, and everything, so that the whole system may be put into operation harmoniously, and make sure that your leaders give it a fair chance at the beginning. The management behind the plan must have courage, faith, and confidence. If you have the conviction that it can be applied to your business, that others have made it succeed, and that you can, then you will succeed in the end. The whole aim in an industrial establishment may be summed up in a concrete phrase: it is the effort to have the right article in the right place in the right quantity and at the right time. If you accomplish that, you will have nearly all you can ask for in the way of movement of material through your plant. This statement, of course, relates only to management of men and material, not to the operation of machines.

As a final word, I would like to say that there have been a good many definitions of efficient management as applied to industrial plants, but here is a new one: that it is a five-thousand-dollar intelligence applied to the study of five-dollar or five-cent jobs and problems to find out how they should be done, and then to teach the five-dollar or the three-dollar or the two-dollar man how to do them. Then your $5,000 intelligence passes on to the next job.